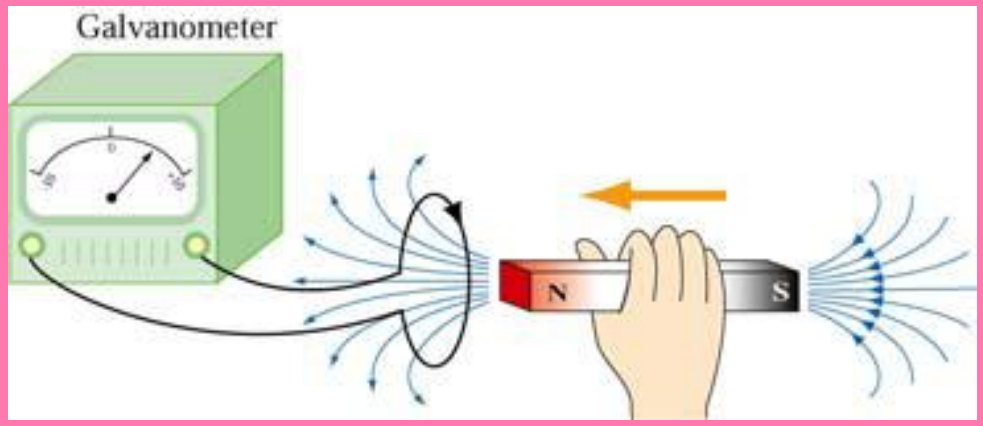
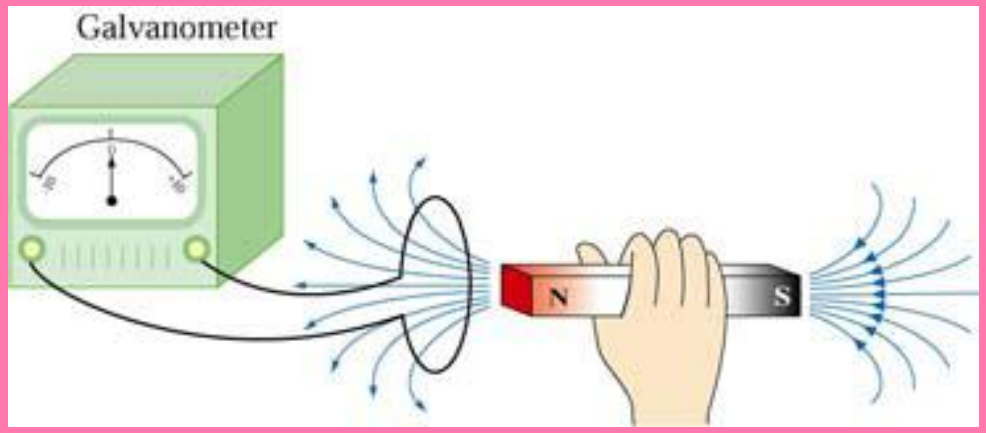
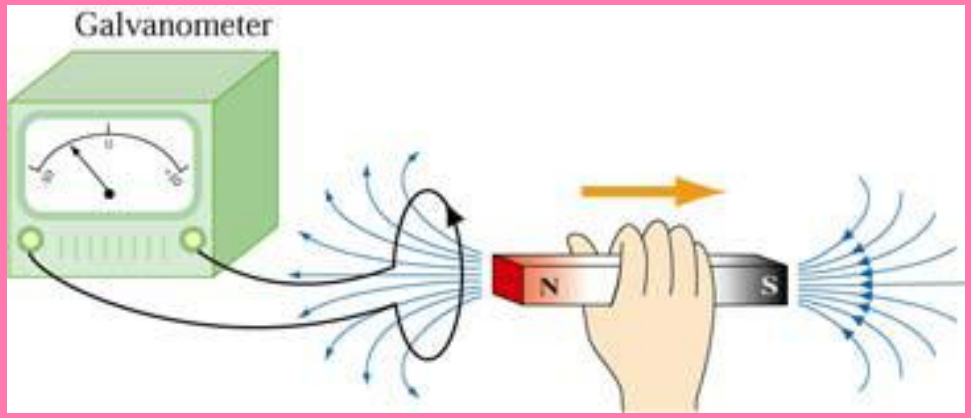
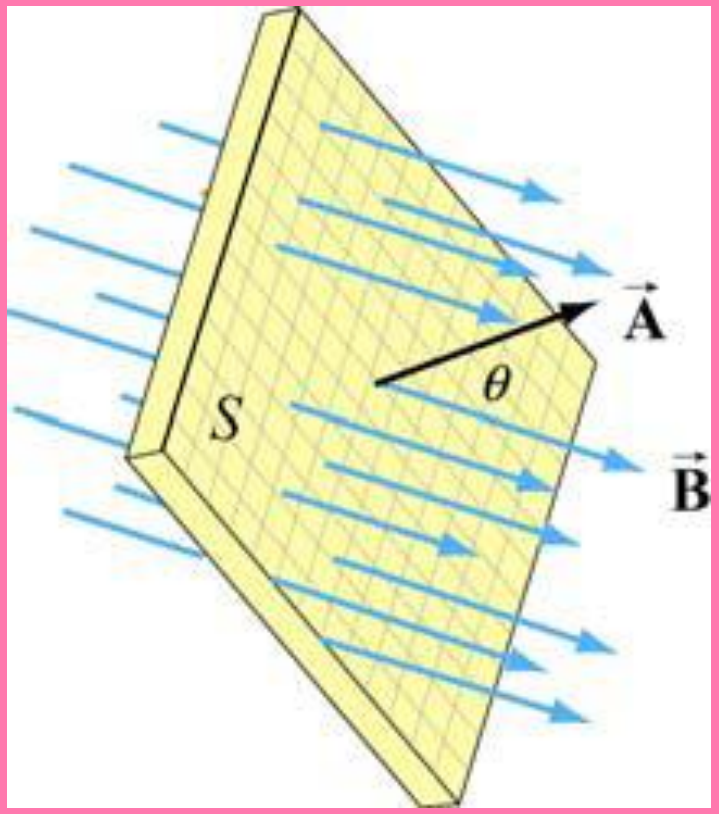
Inducción Electromagnética









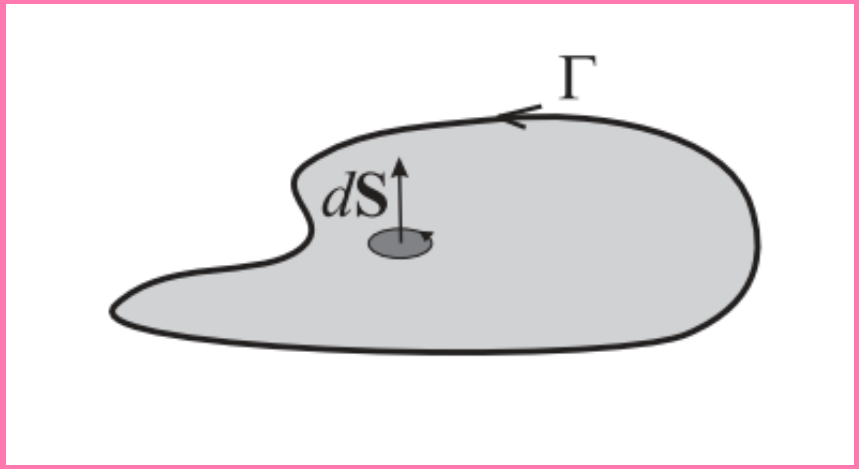
Flujo magnético a través de una superficie

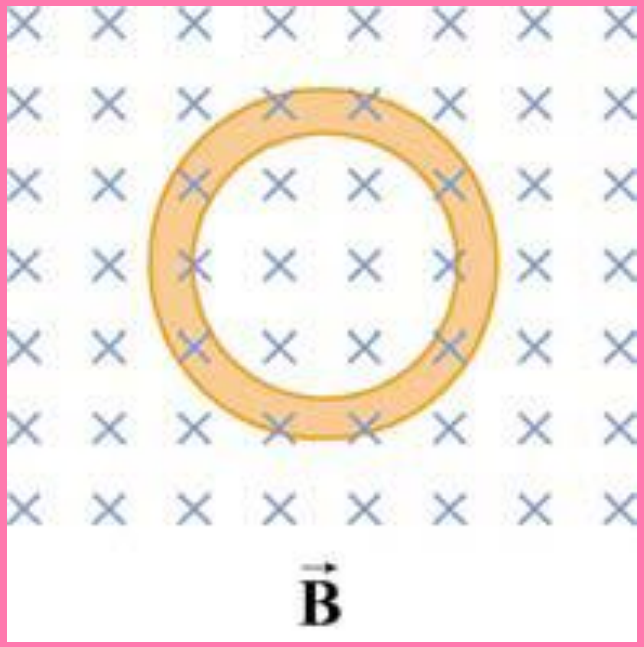
Ley de Faraday

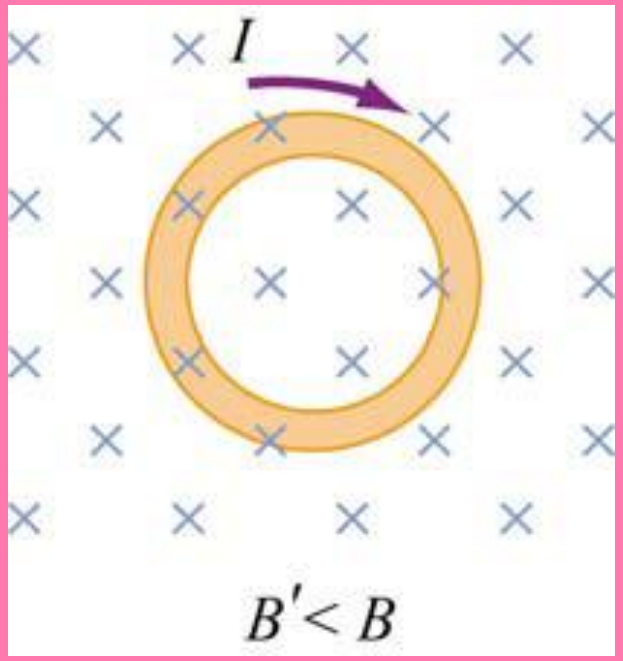
$$\mathcal{E} = -\frac{d\Phi}{dt},$$

La fuerza electromotriz E inducida en un circuito viene dada por la variación temporal del flujo magnético, Φ, que atraviesa dicho circuito.

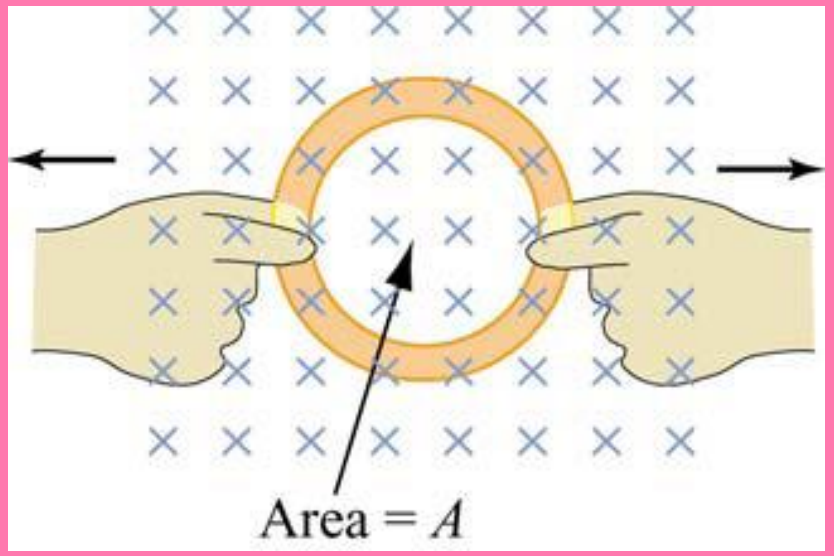
$$\oint_{\Gamma} \mathbf{E} \cdot d\boldsymbol{l} = -\frac{d}{dt} \int_{S(\Gamma)} \mathbf{B} \cdot d\mathbf{S} \,,$$

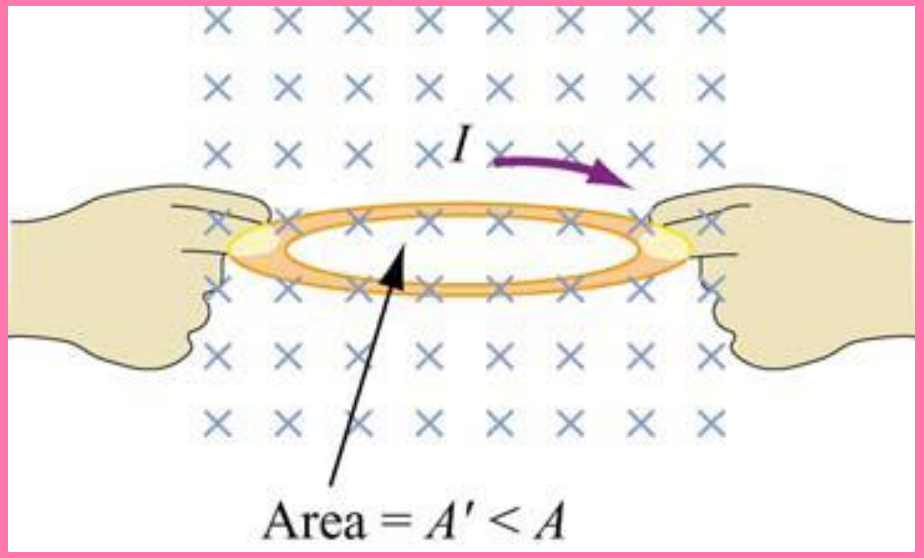




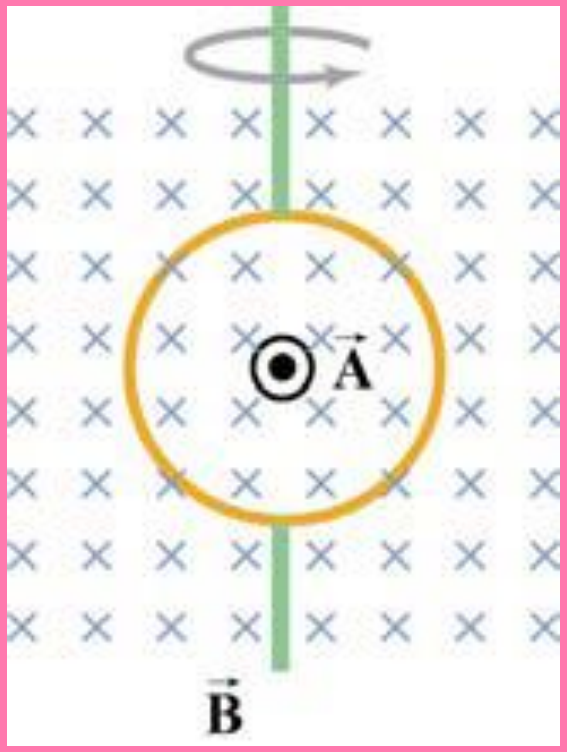


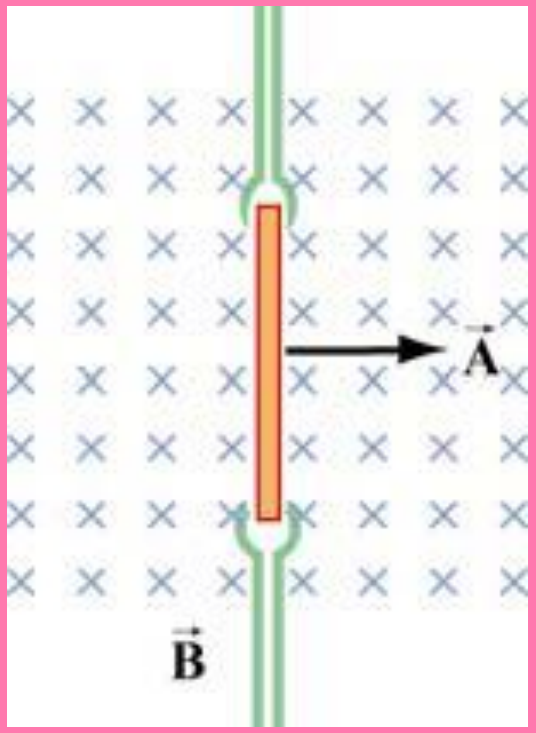
Inducción por variación de intensidad de B



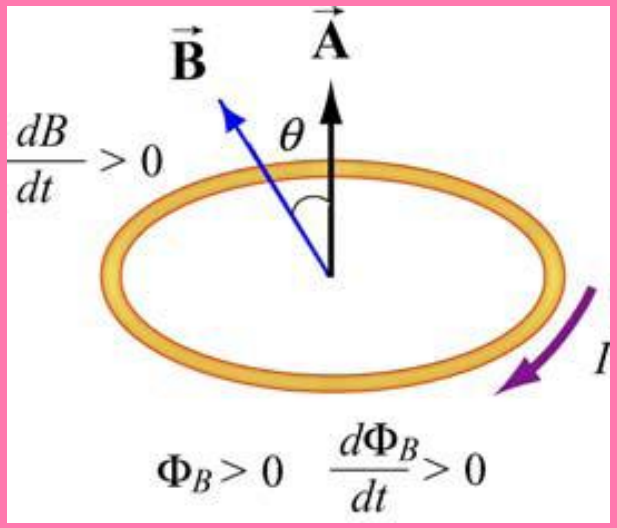


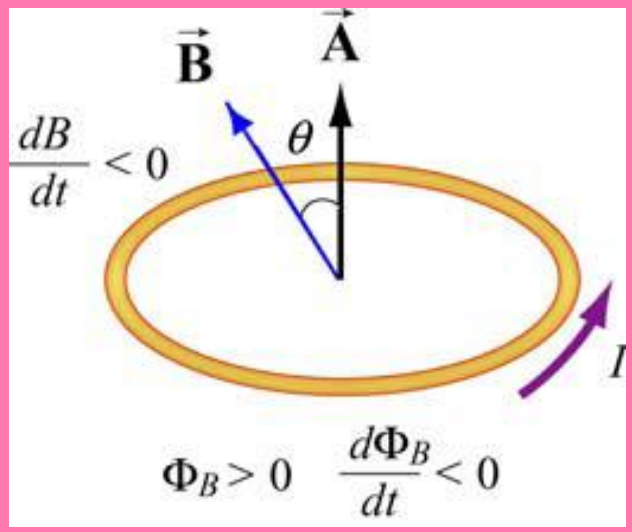
Inducción por variación de área



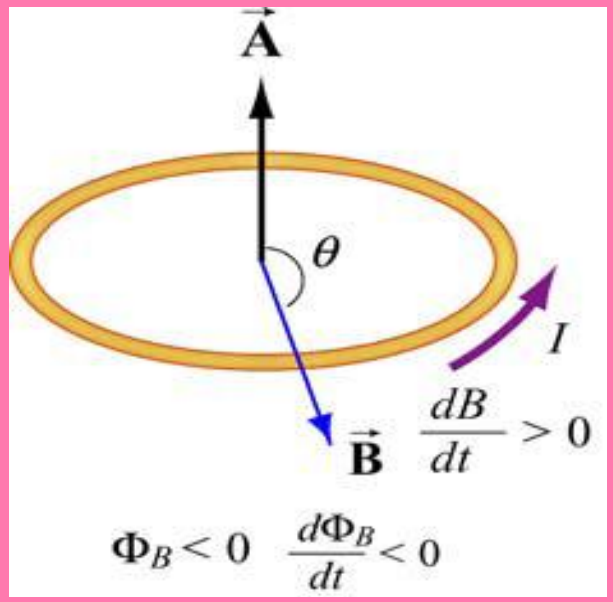


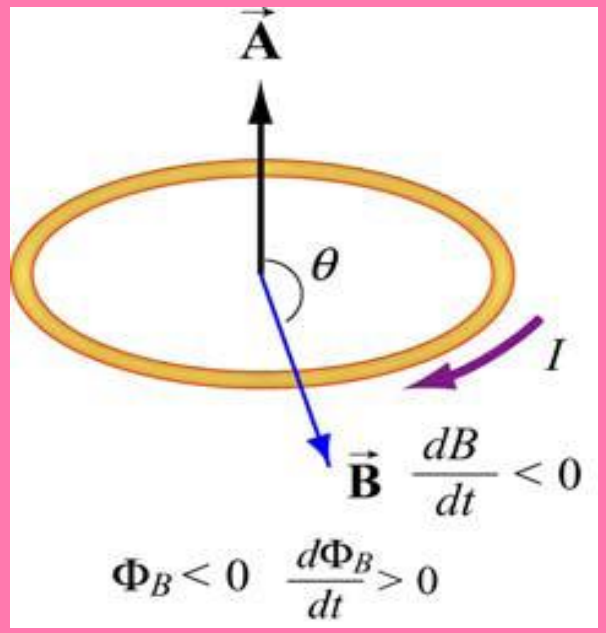
Inducción por variación de ángulo entre B y A

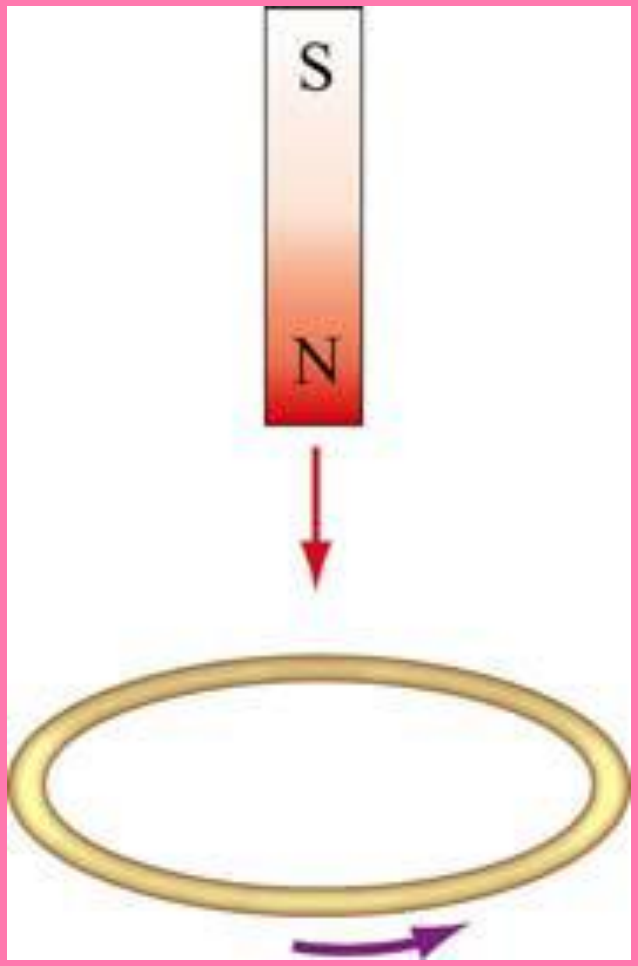

$\vec{B}$
$\vec{A}$
$\frac{dB}{dt} > 0$
θ
I
$\Phi_B > 0$
$\frac{d\Phi_B}{dt} > 0$

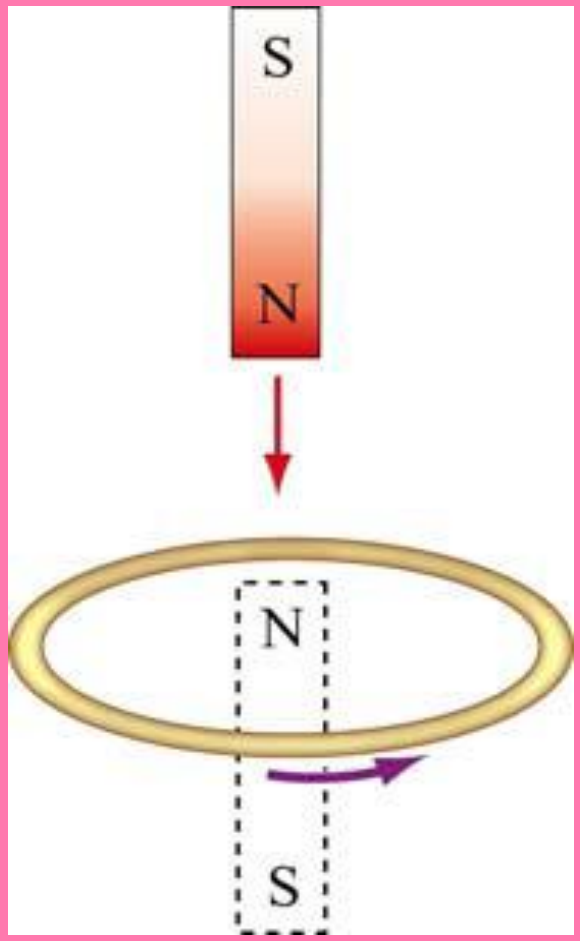

$\vec{B}$
$\vec{A}$
$\frac{dB}{dt} < 0$
θ
I
$\Phi_B > 0$
$\frac{d\Phi_B}{dt} < 0$

Ley de Lenz

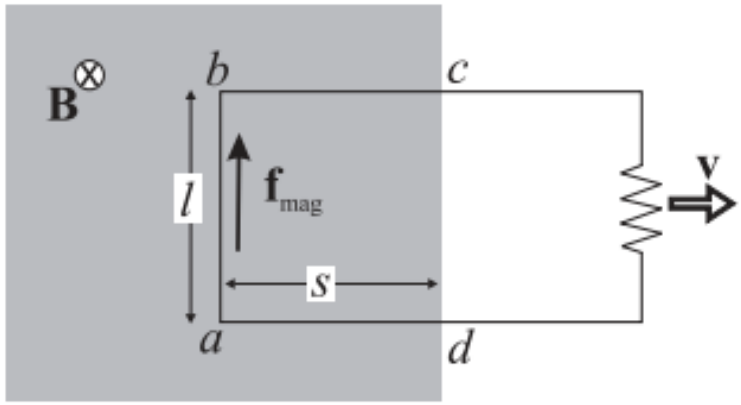

$\vec{A}$
θ
I
$\vec{B}$
$\frac{dB}{dt} > 0$
$\Phi_B < 0$
$\frac{d\Phi_B}{dt} < 0$


$\vec{A}$
θ
I
$\vec{B}$
$\frac{dB}{dt} < 0$
$\Phi_B < 0$
$\frac{d\Phi_B}{dt} > 0$


S
N


S
N
N
S

FUERZA ELECTROMOTRIZ DE MOVIMIENTO



Las cargas móviles del segmento ab experimentarán la siguiente fuerza de Lorentz por unidad de carga:

$$\mathbf{f}_{mag} = \frac{\mathbf{F}_{mag}}{q} = \mathbf{v} \times \mathbf{B} \,,$$

Este impulso dará lugar a una corriente en el circuito debida a la aparición de una fem de valor

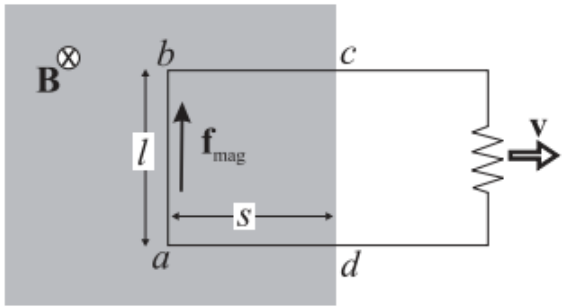
$$\mathscr{E} = \oint \mathbf{v} \times \mathbf{B} \cdot d\boldsymbol{l} \,,$$

En este caso....

$$\mathscr{E} = \int_a^b \mathbf{v} \times \mathbf{B} \cdot d\boldsymbol{l} = \int_a^b vBdl = vBl \,,$$

$$I = \frac{\mathscr{E}}{R} = \frac{vBl}{R} \,.$$

Otra forma. Utilizando la Ley de Faraday



$$\mathcal{E} = -\frac{d\Phi_m}{dt} .$$

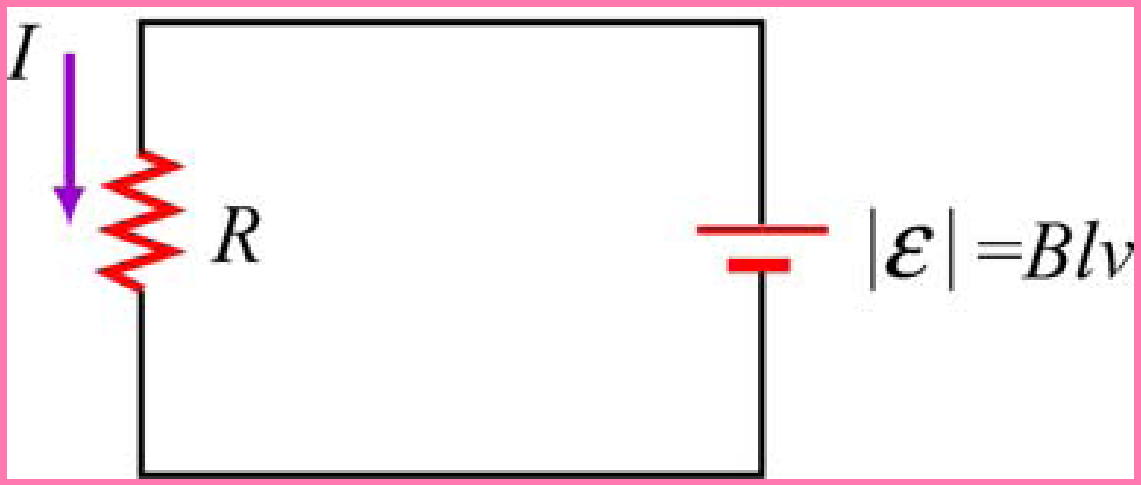
$$\Phi_m = \int_S \mathbf{B} \cdot d\mathbf{S}$$

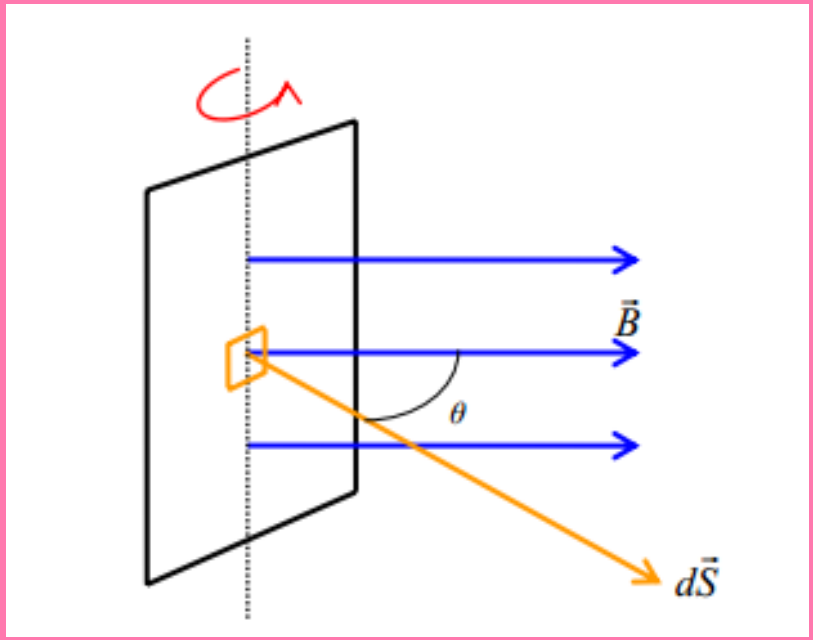
S

$$\Phi_m = \int_S B dS = B \int_S dS = BS = Bls ,$$

$$v = -ds/dt$$

$$\frac{d\Phi_m}{dt} = \frac{d}{dt} Bls = -Blv ,$$


I
R
$|\mathcal{E}| = Blv$



$$d\phi_{mag} = \vec{B}.d\vec{S} = B\,dS\cos\theta$$

$$\phi_{mag} = \int d\phi_{mag} = \int B\,dS\cos\theta = B\cos\theta\int dS = B\cos\theta\,S$$

$$\theta = \omega t$$

$$\phi_{mag} = B\cos(\omega t)\ S = B\,S\cos(\omega t)$$

Si espira consiste en N arrollamientos ...

$$\phi_{mag} = B\cos(\omega t)\ N\,S = B\,N\,S\cos(\omega t)$$

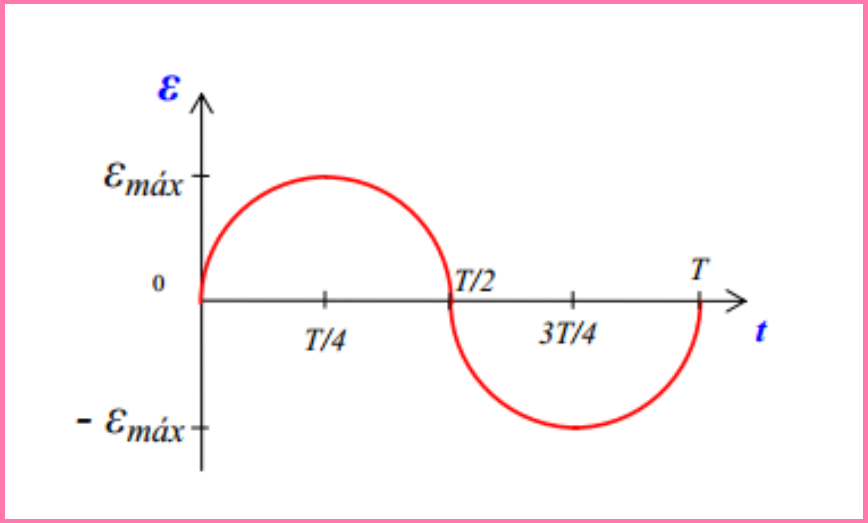
Aplicando Ley de Faraday

$$\varepsilon_{induc} = -\frac{d\phi_{mag}}{dt} = -BNS\omega\left[-sen(\omega t)\right] = (BNS\omega)\,sen(\omega t)$$

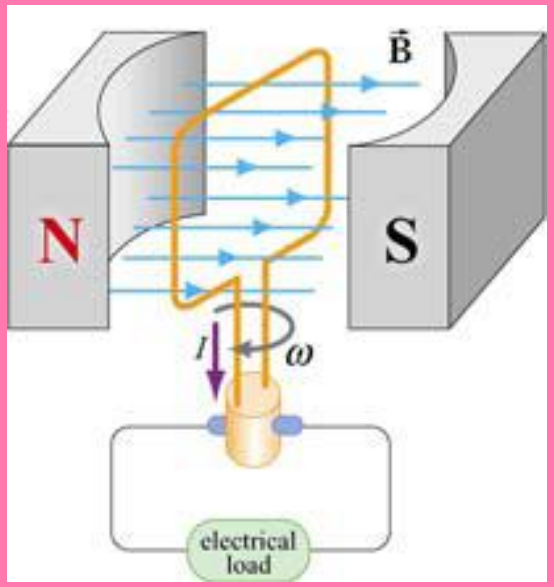
Llamando...

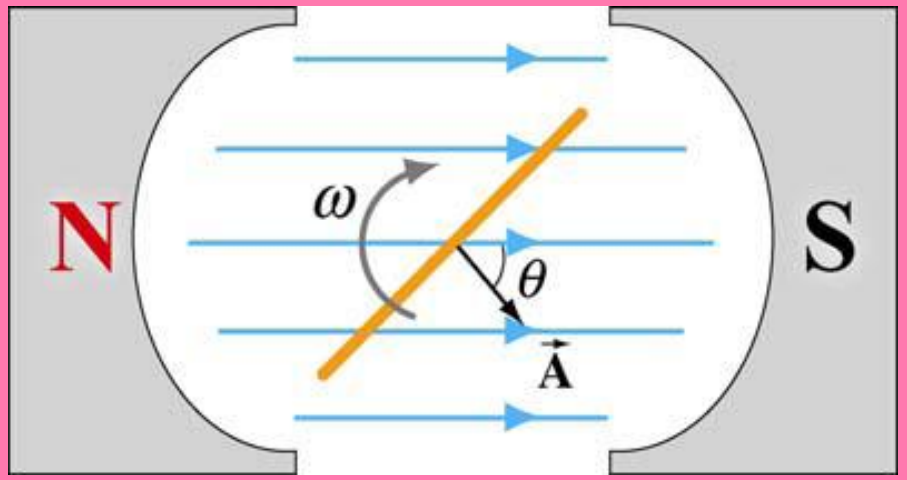
$$\varepsilon_{máx} = BNS\omega$$

$$\varepsilon_{induc} = \varepsilon_{máx}\,sen(\omega t)$$



$$I_{induc} = \frac{\varepsilon_{induc}}{R} = \frac{\varepsilon_{máx}}{R} sen(\omega t) = I_{máx}\ sen(\omega t)$$





Generador de Corriente Alterna

$$\mathcal{E}_{induc} = \mathcal{E}_{máx}\, sen(\omega t)$$

$$I_{induc} = \frac{\mathcal{E}_{induc}}{R} = \frac{\mathcal{E}_{máx}}{R} sen(\omega t) = I_{máx}\, sen(\omega t)$$

Campo eléctrico inducido